Air Quality Monitoring

Canon Ridge/Hermitage Park Area

March 2003 — Final Report

Summary

In November 2001, Petro-Canada submitted an Environmental Impact Assessment (EIA) Report for the approval of the Edmonton Refinery Feed Conversion Program to Alberta Environment. The air modelling in the assessment predicted exceedances of the one-hour Alberta Ambient Air Quality (AAAQ) Guidelines for benzene in the Canon Ridge/Hermitage Park area associated with the existing Petro-Canada Edmonton Refinery and background sources. As a result, Alberta Environment conducted an air quality monitoring survey in the Canon Ridge and Hermitage Park area in March 2003. One-hour samples were collected so a direct comparison could be made to the one-hour AAAQ Guideline for benzene. Since Alberta does not have ambient air quality guidelines for toluene, ethylbenzene, and xylenes, Ontario's Point of Impingement Limits were used for comparison.

A total of seven samples and seven duplicate samples were collected over four days at six different locations from March 12, 2003 to March 28, 2003. The samples were analyzed for benzene, toluene, ethylbenzene, and xylene. Each site was monitored for a minimum of one hour to allow comparison with applicable one-hour ambient air quality guidelines. VOC samples were collected using the Carbotrap 400 adsorbent tube method. Monitoring sites were determined on the sampling day to locate the sampler downwind of industrial facilities.

The objective of the survey was to assess benzene levels in the area where AAAQ Guideline exceedances were predicted in the 2001 Petro-Canada EIA Report. This report presents the VOC data collected by stationary samplers deployed during the survey period. No exceedances of applicable guidelines occurred. Benzene levels were low or below detection levels at the monitoring locations during the times monitored.

ENVIRONMENT

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AIR QUALITY GUIDELINES

The Alberta Ambient Air Quality (AAAQ) Guidelines for one-hour benzene concentrations is 30 $\mu g/m^3$ (micrograms of benzene per cubic meter of air). The Alberta one-hour guideline of 30 $\mu g/m^3$ for benzene is based on the former Texas Natural Resources Conservation Commission (TNRCC) short-term Effects Screening Level (ESL). The value was derived by applying a factor of ten to the TNRCC long-term (annual) ESL of 3 $\mu g/m^3$. In 1996, the TNRCC short-term ESL was changed from 30 $\mu g/m^3$ to 75 $\mu g/m^3$. The ESL was changed because it was deemed to be too conservative for the evaluation of short-term modelling impacts for air permits.
Alberta does not have ambient air quality guidelines for toluene, ethylbenzene or xylenes.

In the absence of a guideline in Alberta, the Ontario Point of Impingement (POI) Limits were used for comparison with ambient air concentrations. The Point of Impingement is defined by the Ontario Ministry of Environment as: "Any point on the ground or on a receptor, such as nearby buildings, located outside the company's property boundaries at which the highest concentration of a contaminant caused by the aggregate emission of that contaminant from a facility is expected to occur"[1]. In Ontario, the POI is used in the regulatory permitting process: predicted maximum POI concentrations obtained from dispersion modelling are compared with the corresponding half-hour POI Limit. Ontario POI Limits do not have regulatory standing in Alberta and are used for comparison purposes only. Table 1 presents the Alberta Ambient Air Quality Guidelines, Ontario Point of Impingement Limits, and odour thresholds[2] for BTEXs.

Table 1. Air quality guidelines, point of impingement limits and odour thresholds for benzene, toluene, ethylbenzene and total xylenes ($\mu g/m^3$)

	Benzene	Toluene	Ethylbenzene	Xylenes
Alberta Ambient Air Quality Guideline (one-hour)	30	n/a	n/a	n/a
Ontario Point of Impingement Limit (half-hour)	n/a*	2000	3000	2300
Odour Threshold[2]	4500	8025	8700	348

* - No assigned standard or guideline. Emissions to the environment are to be prevented or limited to the greatest extent possible.

[1] *Ontario Minister of the Environment.* 1998. Procedure for Preparing an Emission Summary and Dispersion Modelling Report.
[2] Ruth, J.H. 1986. *Odor thresholds and irritation levels of several chemical substances: a review.* Am. Ind. Hyg. Assoc. J47:pp. 142 - 151.

BACKGROUND

Petro-Canada submitted an Environmental Impact Assessment (EIA) Report to Alberta Environment in November 2001 for the approval of the Edmonton Refinery Feed Conversion Program. The air modelling in the assessment predicted exceedances of the one-hour Alberta Ambient Air Quality (AAAQ) Guidelines for benzene in the Canon Ridge/Hermitage Park area associated with the existing Petro-Canada Edmonton Refinery and background sources (Figure 1). Volatile organic compound (VOC) samples were collected in the Canon Ridge/Hermitage Park area in Edmonton from March 12, 2003 to March 28, 2003 to assess benzene levels in the area where ambient air quality guideline exceedances were predicted. One-hour sampling of VOCs (including Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)) were collected over this time period at six different sites located downwind from industrial sources in the Canon Ridge/Hermitage Park area.

MONITORING FOR VOLATILE ORGANIC COMPOUNDS

Volatile organic compounds (VOCs) include a large group of chemicals containing carbon and hydrogen atoms that can react quickly to form other chemicals in the atmosphere. They are important because they can present a health risk to humans, animals and vegetation. VOCs can also react with oxides of nitrogen (NO_x) to form ozone (O_3), a health hazard and major contributor to smog.

VOCs are emitted from both natural and anthropogenic sources. Natural sources of VOC's include forests, grasslands and swamps. Major sources of VOCs in the outdoor environment include automobile emissions, gasoline stations and gasoline storage tanks, petroleum and chemical industries, and natural gas combustion. Other sources of VOCs include the evaporation of solvents as well as leaking valves, flanges, pumps and compressors at industrial facilities. VOCs are also contained in incinerator and flare stack emissions associated with the oil and gas industry. The VOCs monitored in the Canon Ridge/Hermitage Park area survey were benzene, toluene, ethylbenzene and xylenes, often referred to as BTEX compounds.

Benzene

Benzene is a colourless gas with a sweet odour. It is a known cancer causing substance if one is exposed to high concentrations for a prolonged period of time. Benzene is recognized as a chemical "concluded to be toxic" on the Environment Canada First Priority Substances List (PSL1).[3] It is ranked sixth on the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR) list of hazardous substances.[4] Major sources of benzene include vehicle exhaust, automobile service stations and industrial emissions. The most significant source of benzene in ambient urban air is generally considered to be vehicle operations. Steps have been taken to reduce the benzene content of gasoline and to reduce fuel losses. Concentrations of benzene in Edmonton have decreased 52% in downtown Edmonton (1992-2000). In east Edmonton average benzene levels have decreased by 51%. Common indoor sources of benzene include tobacco smoke, glues, paint, furniture wax and detergents. Tobacco smoke accounts for nearly half the national exposure to benzene.[5]

Toluene

Toluene is a colourless gas with a distinctive sweet and pungent odour. It is produced during gas processing and contained in paints, paint thinners, fingernail polish, lacquers and adhesives. Vehicle exhaust is also a major source of toluene. Toluene has been recognized on the PSL1 list as a chemical "not concluded to be toxic".[3] Toluene is ranked 68th on the ATSDR list of hazardous substances.[4]

Ethylbenzene

Ethylbenzene is a colourless gas with a distinctive aromatic odour. It is used in the manufacturing of styrene, plastics, synthetic rubber and latex products. Ethylbenzene is also used as a solvent and is a component of gasoline. Ethylbenzene is not included on the PSL list. Ethylbenzene is ranked 91st on the ATSDR list of hazardous substances.[4]

Xylenes

Total xylenes include m-, p-, and o-xylenes. Xylenes are colourless and have a sweet odour when emitted into the atmosphere. Xylenes are used in solvents, cleaning agents, paint thinner, paints and varnishes. Gasoline and forest fires also produce xylenes. Xylenes are recognized as chemicals "not concluded to be toxic" on the PSL1 list.[3] Xylenes are ranked 48th on the ATSDR list of hazardous substances.[4]

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[3] Environment Canada.Priority Substances List1 *ww.ec.gc.ca/substances/ese/eng/psap/psl1-1.cfm*

[4] Agency for Toxic Substances and Disease Registry. *2001 CERCLA List of Priority Hazardous Substances. www.atsdr.cdc.gov/clist.html*

[5] Agency for Toxic Substances and Disease Registry (ATSDR). *Toxicological Profile for Benzene* (Draft). U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1997.

Figure 1. Maximum predicted one-hour average ground-level benzene concentrations (μg/m^3) associated with the existing Petro-Canada Refinery and background sources.[6]

[6] Petro-Canada. Application for Approval of Edmonton Refinery Feed Conversion Program. November 2001.

MONITORING METHOD

A total of fourteen samples were collected at six locations during the Canon Ridge/Hermitage Park area survey. The samples were collected for one-hour periods at each site.

One-hour samples were collected so that a direct comparison could be made to one-hour ambient air quality guidelines for benzene. Since Alberta does not have ambient air quality guidelines for toluene, ethylbenzene, and xylenes Ontario's Point of Impingement Limits were used for comparison.

VOC samples were collected using the Carbotrap 400 adsorbent tube method. This method uses a pump that requires only battery power and is relatively inexpensive and easy to operate in the field.

The Carbotrap 400 tube consists of a glass tube 10.6 cm long with a 0.4 cm inside diameter packed with an adsorbent media called Carbotrap. Air is drawn through this tube by way of a battery-powered pump at a low flow rate (1.5 L/hour and 6 L/hour) for a defined period of time (e.g. one hour) (Figure 2). The Carbotrap is specifically formulated to adsorb a number of different hydrocarbon species. The tube is then analyzed by gas chromatography/mass spectroscopy to quantify ambient concentrations of the hydrocarbons of interest, i.e. benzene. This monitoring method conforms to the U.S. Environmental Protection Agency (EPA) Compendium Method TO-17.[7] In this survey, Carbotrap tubes were analyzed for benzene, toluene, ethylbenzene and xylenes (BTEX).

Seven samples and seven duplicates were collected over four days at various locations in the Canon Ridge/Hermitage Park area (Figure 3). The exact location within the community was determined on the sampling day to locate the sampler downwind of industrial facilities. The rationale for the sampling locations chosen is indicated in Table 3. The samples were analyzed for BTEX at Envirotest Laboratories in Edmonton. Two laboratory and two field blanks were analyzed for QA/QC purposes. Detection limits are summarized in Table 3; good precision was obtained in all samples analyzed.

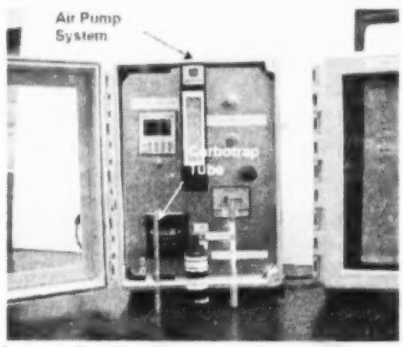

Figure 2. Carbotrap tube and air pump system

[7] U.S. Environmental Protection Agency, 1999, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air: Second Edition. Compendium Method TO-17: Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes.* EPA/625/R-96/010b.

RESULTS

Analysis of the data summarized in Table 3 indicates that benzene concentrations in all samples collected during the time of the Canon Ridge/Hermitage Park area survey were below Alberta's one-hour ambient air quality guideline. Concentrations of toluene, ethylbenzene, and xylenes collected during the Canon Ridge/Hermitage Park area survey were low and no guidelines or standards were exceeded. Concentrations of benzene, toluene, ethylbenzene, and xylenes were below odour thresholds.

Benzene concentrations in all samples collected in this survey did not exceed 2.0 $\mu g/m^3$. Concentrations of ethylbenzene and xylenes were below the detection limit for all samples, and toluene concentrations did not exceed 3.0 $\mu g/m^3$. BTEX concentrations in samples collected in the Canon Ridge/Hermitage area survey are summarized in Table 3.

The observed benzene concentrations in the Canon Ridge/Hermitage Park area survey were well below the predicted concentrations from the Petro-Canada EIA Report. Figure 1 illustrates the predicted one-hour average ground-level benzene concentrations associated with the existing Petro-Canada Edmonton Refinery and background sources.

The Edmonton Central and Edmonton East Air Monitoring Stations collect 24-hour benzene samples on the National Air Pollution Surveillance (NAPS) schedule, which is once every six days. Benzene data from 1990 to 2002 were obtained and annual maximum 24-hour benzene concentrations were extracted. At these stations, ambient air samples are collected in stainless steel canisters and are analyzed using a cryogenic pre-concentration technique with a high resolution gas chromatograph and quadropole mass-selective detector (GC-MSD). As the sampling and analysis method differs from the sampling method in the Canon Ridge/Hermitage Park survey, the results from the Edmonton Central and Edmonton East stations are not directly comparable. However, it is worthwhile to note that a maximum annual 24-hour benzene concentration of 19.27 $\mu g/m^3$ was obtained in 1991 at the Edmonton East station. Maximum annual 24-hour benzene concentrations in 2002 were 6.59 $\mu g/m^3$ and 4.23 $\mu g/m^3$ at the Edmonton East and Edmonton Central stations, respectively (Table 2). Ambient air levels of benzene in Canada have shown a decline at most urban sites and is a result of improved VOC emission control technology on new motor vehicles plus the effect of reduced gasoline benzene levels[8].

As this survey was meant to be a preliminary study to assess benzene levels in the area where AAAQ Guideline exceedances were predicted in the 2001 Petro-Canada EIA Report, monitoring across all four seasons would be desirable. However, as the BTEX concentrations monitored in the Canon Ridge/Hermitage Park survey were low, further

[8] Environment Canada. Environmental Technology Advancement Directorate. 1999. Ambient Air Measurements of Benzene in Canada (1989-1998). Unpublished Report

seasonal monitoring to confirm the modeling predictions from the Petro-Canada EIA report is likely not needed at this time.

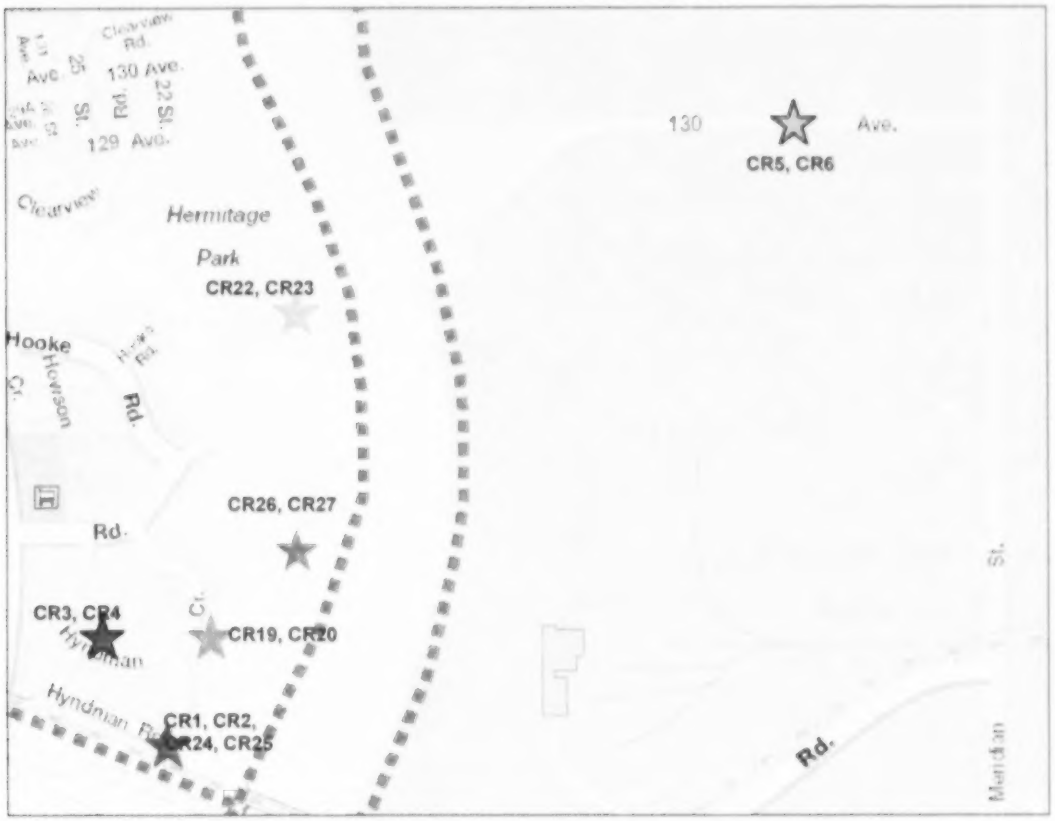

Figure 3. Sampling Locations for the Canon Ridge/Hermitage Park area survey

Table 2. National Air Pollution Surveillance. Maximum Benzene Concentrations ($\mu g/m^3$)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Edmonton East	6.31	19.27	12.72	7.66	7.03	9.27	4.69	14.80	6.32	5.54	8.29	5.08	6.59
Edmonton Central	-	11.95	9.63	7.73	13.55	9.67	6.49	5.92	7.30	4.25	3.88	4.29	4.23

Table 3. Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations in the Canon/Ridge Hermitage Park Area Survey

					Benzene	Toluene	Ethylbenzene	Xylenes	
				ADL	0.01 μg	0.01 μg	0.01 μg	0.03 μg	
Site #	Date	Sampling Time	Sampling Location	Sample Flow Rate (L/hr)	μg/m^3	μg/m^3	μg/m^3	μg/m^3	Operator Comments
CR19	12-Mar	1135-1238	150m S of Hyndman Cres on Hyndman Rd. 5 m east from Rd.	1.5	<6.7	<6.7	<6.7	<20.0	Overcast with light winds from the NE. Wind shift and coming from the south at 1200 hours. No local source interferences.
CR20	12-Mar	1138-1238	150m S of Hyndman Cres on Hyndman Rd. 5 m east from Rd.	6	2	3	<2	<5	Duplicate sample
CR22	12-Mar	1310-1410	North end of Hemitage Park at closest road to river, about 50-60m	1.5	<6.7	<6.7	<6.7	<20.0	Wind from SE. Intermittent odours from Celanese Plant

ADL – Analytical Lower Detection Limit

Table 3. Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations in the Canon/Ridge Hermitage Park Area Survey (cont.)

					Benzene	Toluene	Ethylbenzene	Xylenes	
				ADL	0.01 µg	0.01 µg	0.01 µg	0.03 µg	
Site #	Date	Sampling Time	Sampling Location	Sample Flow Rate (L/hr)	µg/m^3	µg/m^3	µg/m^3	µg/m^3	Operator Comments
CR23	12-Mar	1310-1410	North end of Hemitage Park at closest road to river, about 50-60m	6	2	<2	<2	<5	Duplicate sample. Heavy snow starting at 1405 hours. No local source interferences.
CR24	13-Mar	0950-1050	SE corner of Hyndman Rd.	6	2	<2	<2	<5	NE wind at about 10kph. Sample straigh downwind of Celanese. Odours from facility.

ADL – Analytical Lower Detection Limit

Table 3. Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations in the Canon/Ridge Hermitage Park Area Survey (cont.)

					Benzene	Toluene	Ethylbenzene	Xylenes	
				ADL	0.01 µg	0.01 µg	0.01 µg	0.03 µg	
Site #	Date	Sampling Time	Sampling Location	Sample Flow Rate (L/hr)	µg/m^3	µg/m^3	µg/m^3	µg/m^3	Operator Comments
CR25	13-Mar	0950-1050	SE corner of Hyndman Rd.	1.5	<6.7	<6.7	<6.7	<20.0	Duplicate Sample. Plume direction is travelling overhead and toward WNW.
CR27	13-Mar	1146-1246	South end of Hermitage Park about 100m from river	6	2	<2	<2	<5	Light NE winds, Plume from Celanese is directly over sampling location. Light odours.
CR26	13-Mar	1146-1246	South end of Hermitage Park about 100m from river	1.5	<6.7	<6.7	<6.7	<20.0	Duplicate Sample

ADL – Analytical Lower Detection Limit

Table 3. Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations in the Canon/Ridge Hermitage Park Area Survey (cont.)

					Benzene	Toluene	Ethylbenzene	Xylenes	
				ADL	0.01 µg	0.01 µg	0.01 µg	0.03 µg	
Site #	Date	Sampling Time	Sampling Location	Sample Flow Rate (L/hr)	µg/m^3	µg/m^3	µg/m^3	µg/m^3	Operator Comments
CR1	13-Mar	1544-1644	SE corner of Hyndman Rd.	6	2	<2	<2	<5	ENE wind between 10-15kph. Pick up odours. Wind changed to a light ESE direction during sample period.
CR2	13-Mar	1544-1644	SE corner of Hyndman Rd.	1.5	<2	<2	<2	<5	Duplicate Sample
CR3	14-Mar	1011-1111	100m north of Hyndman Rd on Hyndman Cres.	6	2	2	<2	<5	Light ENE wind with inversion type conditions. Slight odours.
CR4	14-Mar	1011-1111	100m north of Hyndman Rd on Hyndman Cres.	1.5	<6.7	<6.7	<6.7	<20.0	Duplicate Sample

ADL – Analytical Lower Detection Limit

Table 3. Benzene, Toluene, Ethylbenzene, and Total Xylenes Concentrations in the Canon/Ridge Hermitage Park Area Survey

					Benzene	Toluene	Ethylbenzene	Xylenes	
				ADL	0.01 µg	0.01 µg	0.01 µg	0.03 µg	
Site #	Date	Sampling Time	Sampling Location	Sample Flow Rate (L/hr)	µg/m^3	µg/m^3	µg/m^3	µg/m^3	Operator Comments
CR6	28-Mar	1034-1134	500 m west of Meridian St. on 130 Ave (road to Epcor)	6	2	<2	<2	<5	North and downwind of Celanese about 900m-1km. South wind at 17-20kph. Light odours
CR5	28-Mar	1034-1134	500 m west of Meridian St. on 130 Ave (road to Epcor)	1.5	<6.7	<6.7	<6.7	<20.0	Duplicate Sample

ADL – Analytical Lower Detection Limit